



# Landslides within the Larch Dominant Permafrost Zone of Central Siberia

K. J. Ranson<sup>1</sup>, VI Kharuk<sup>2</sup>

<sup>1</sup>NASA GSFC Code 618, <sup>2</sup>Sukachev Institute of Forests, Krasnoyarsk, Russia

Figure 1

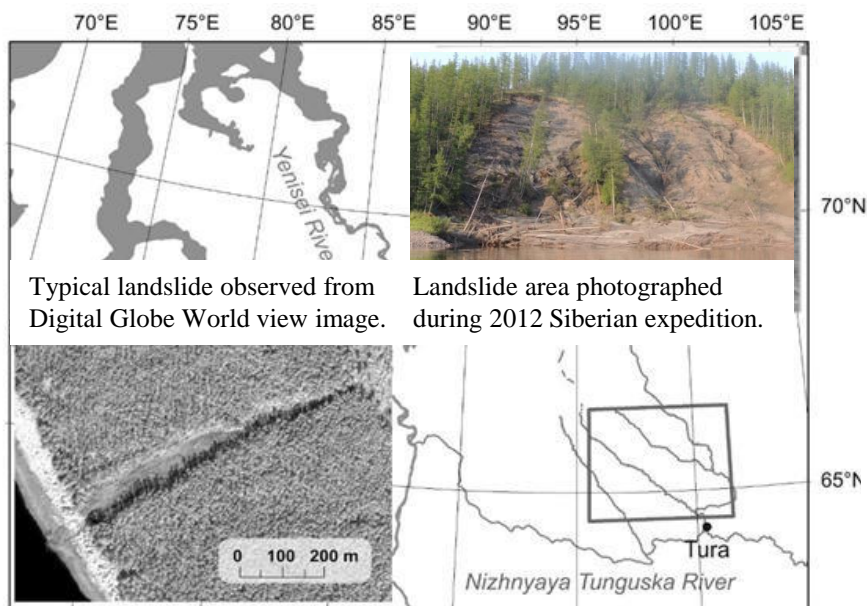
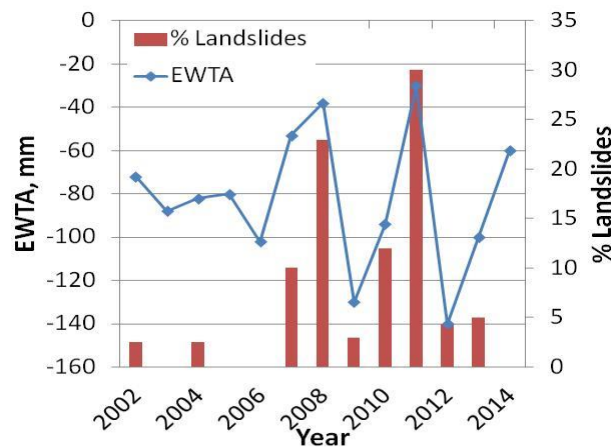


Figure 2



Pearson's Correlation between climate variables and landslide occurrence. \*, \*\* – significant at  $p < 0.05$  and  $p < 0.1$ , respectively.

Climate variable	Annual	May	June	July	August
Precipitation	0.37	0.13	0.02	0.39	0.81*
EWTA	0.54**	0.39	0.68**	0.70*	0.69*
Temperature	37	51**	0.01	0.13	0.21

Landslides are frequently observed on south facing along rivers in central Siberia. The frequency of landslides has increased over past decades and is correlated positively to precipitation, temperature, as well as equivalent of water thickness anomaly (EWTA, measured in mm) from the GRACE mission. Impact of landslides on boreal forests and water quality needs to be better understood.



Name: Jon Ranson, GSFC Code 618  
E-mail: kenneth.j.ranson@nasa.gov  
Phone: 301-614-6650

## References

Kharuk, Viacheslav I.; Shushpanov, Alexandr S.; Im, Sergei T.; Ranson, K.J. 2016. Climate-induced land sliding within the larch dominant permafrost zone of central Siberia. Environmental Research Letters 11(4) No. 045004 DOI: 10.1088/1748-9326/11/4/045004

Neigh, C.S., Masek, J.G. and Nickeson, J.E., 2013. High-resolution satellite data open for government research. Eos, Transactions American Geophysical Union, 94(13), pp.121-123.

**Data Sources:** WorldView-1, -2 and QuickBird-2 high-resolution (pixel size 0.5–0.6 m) scenes (Neigh et al 2013), Landsat-5, -7 panchromatic band (pixel size 15 m), and gravimetric measurements (GRACE, Gravity Recovery and Climate Experiment; <http://www.csr.utexas.edu/grace>)

## Technical Description of Figures:

**Graphic 1:** *The study area (rectangle) was north of the town of Tura near the Arctic Circle in central Siberia. Images show examples of landslide observations from (Left) Digital Globe's Worldview satellite and (Right) from a boat on the Embechime River acquired summer 2012.*

**Graphic 2:** *Top graph illustrates the relationship between GRACE Equivalent Water Thickness Anomaly (EWTA) and landside occurrence expressed as the percentage of landslides for a given year. 145 landslides were analyzed. The table shows Pearson's correlation coefficient between precipitation, EWTA, temperature and landslide occurrence. Significant correlations are bolded and indicate importance of spring time temperatures and late summer precipitation as factors for land sliding in this region.*

*Colleagues from Sukachev including S. Im, and A. Shushpanov and GSFC including G. Sun and C. Neigh contributed to this study.*

**Scientific significance, societal relevance, and relationships to future missions:** This work demonstrates that landslides and environmental contributing factors can be monitored using a combination of fine and coarse resolution satellite data. These techniques may be applicable across Siberia and other permafrost areas including regions where human populations might be affected. This work supports the requirement for high resolution imagery as well as a follow-on gravity recovery mission.